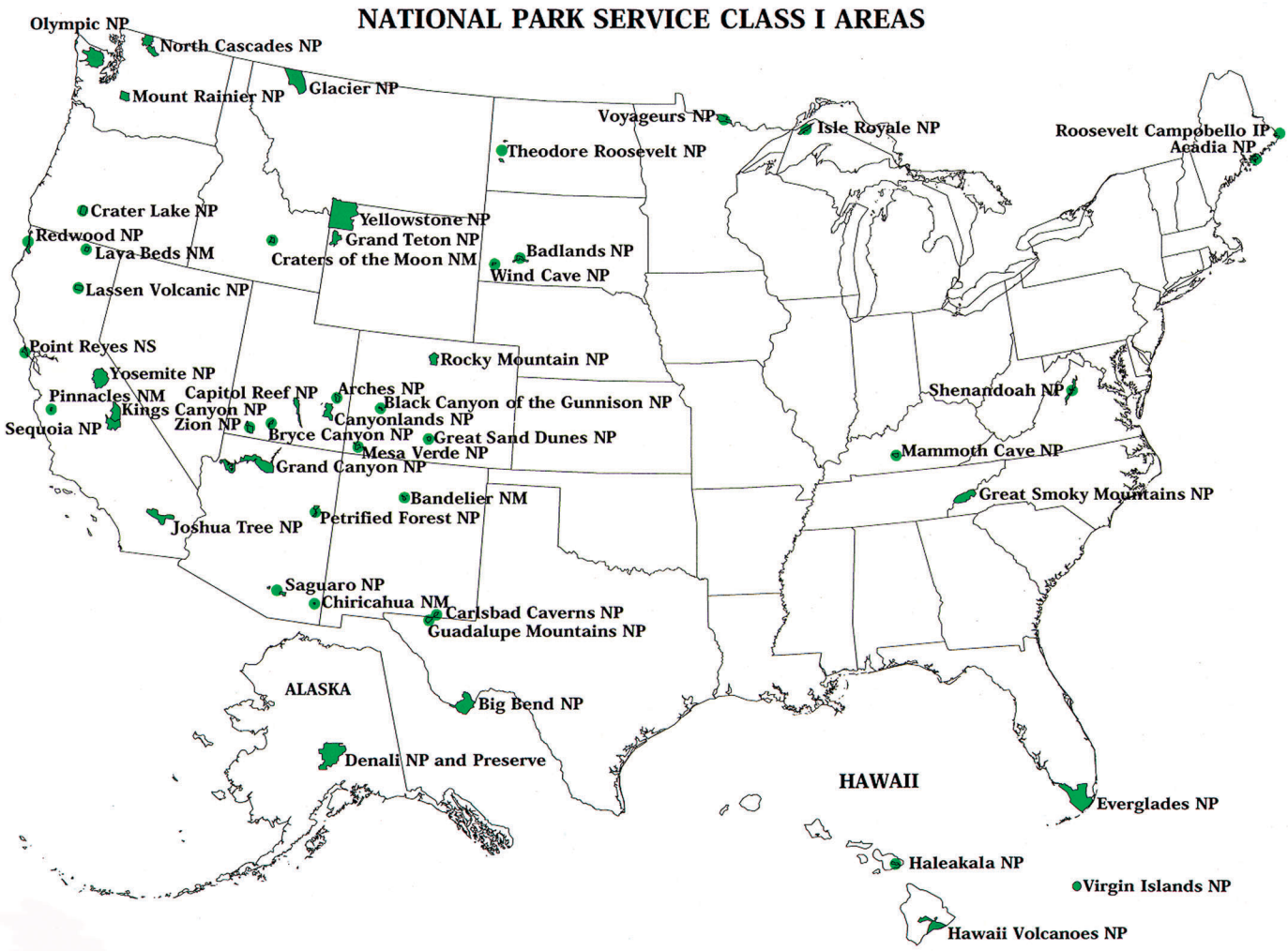


"The National Park Service has the responsibility to protect and preserve the resources and values of all of the parks in our National Park System and that includes parks in every state and in both urban and rural locations. While air quality statutes are basically designed to protect the parks designated Class I under the Clean Air Act, concern for improved air quality is not so restricted. No one should take for granted and accept the degraded air quality in urban and industrial areas like the Indiana Dunes National Lakeshore. We need to continue to express our concern for the health of the visiting and resident public and the survival of the living resources of the park at places like this as well."

Dale B. Engquist, Superintendent
Indiana Dunes National Lakeshore

Chapter One

Preserving Air Quality in National Parks

Our mandate

Since the establishment of Yellowstone National Park in 1872 as the first national park, people from all over the world have come to experience America's national parks. In the year 2000 alone, an estimated 286 million visitors came to national parks, nearly a 40 percent increase since 1979 and a number roughly equal to the U.S. population.

People come to national parks for a variety of reasons such as their desire to experience the natural beauty of, or be inspired by, these icons of our nation's natural and cultural heritage. Many see parks as places of solace and refuge from an increasingly complex, technological, and fast-paced society. Visitors to national parks expect clean, clear air as part of their park experience. They cherish the natural resources and majestic vistas associated with parks, such as those found at Glacier, Grand Canyon, Shenandoah, and Yosemite National Parks. Even those who do not visit national parks recognize the importance of parks as part of our national heritage, and they place a high value on preserving these areas.

Monitoring conducted in national parks over the past 20 years documents that, in most parks, air quality is better than standards set by the Environmental Protection Agency (EPA) to protect public health and welfare. In addition, air quality is improving or remaining stable in about half the parks where monitoring occurs. Some parks occasionally experience essentially pristine air quality conditions unaffected by air pollution. Unfortunately, air quality in national parks is not always as pristine as people may think nor are park natural resources free of noticeable impacts.

Air pollution effects

Many park resources and values are affected by air pollution. For example, the ability to appreciate scenic vistas is highly dependent on good visibility. Poor visibility caused by air pollution can indicate that there may be other impacts occurring to resources that cannot be readily observed. Human-made pollution can injure various species of trees and other plants, acidify streams and lakes, leach nutrients from soils, and erode buildings and monuments. Air pollution may also be causing or exacerbating respiratory symptoms for some of the visitors and employees at several of our national parks. The harmful effect of air pollution on the park visitor's visual and recreational experience is particularly relevant given the increase in visitor use of the national parks.

These are hardly the conditions that Congress foresaw in 1916 when it created the National Park Service (NPS) and established as its fundamental mission

> *"... to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."*

Included in this mission is the mandate to preserve the air quality of our national parks. Congress also emphasized the need to preserve air quality in our nation's special places, including large national parks and wilderness areas, when it amended the Clean Air Act in 1977. Congress mandated that air quality in these areas be protected and enhanced, and not be allowed to deteriorate significantly. It also established a national goal of restoring natural visibility in these areas.

Progress has been made in improving air quality across the country since the enactment of the Clean Air Act in 1970. Nonetheless current air quality in many national parks is far from what can be considered natural conditions. Parks continue to have noticeable impacts on their resources and in some cases their air quality is deteriorating significantly. Air pollution associated with this country's increased industrialization and urbanization over the last several decades is adversely affecting sensitive natural and cultural resources, including visibility, at

Images of some of the clearest days and haziest days experienced at Yosemite and Shenandoah National Parks. Visibility conditions in national parks are being affected by air pollution. Human-caused air pollution in the form of fine particles can wash out the views that visitors come to experience.

Source: NPS Air Resources Division

Panoramic view at Yellowstone National Park

Source: NPS Air Resources Division

"The value of clean air, the pay-off for cleaning up our dirty airsheds will be measured both in the aesthetics of better views, and clearer night skies, but also in the economics of our entire planet. The threat of global warming and a wholesale shift in the productivity of our environment can be managed if we manage the bubble of air that envelops us."

Ellis Richard, Superintendent Guadalupe Mountains National Park, Texas

"... to preserve, protect, and enhance the air quality in national parks, national wilderness areas, national monuments, national seashores, and other areas of special national or regional natural, recreational, scenic, or historic value."

From the 1977 Clean Air Act Amendments, Part C, Prevention of Significant Deterioration of Air Quality

many NPS areas. To prevent or remedy any harmful effects from air pollution the NPS must understand how air quality affects park resources and visitor enjoyment, and work cooperatively with regulatory agencies to prevent or reduce air pollution. In light of current population and economic growth trends; restoring and maintaining good air quality in national parks will continue to be a challenge.

Management policies

NPS management policies address the need to protect units of the National Park System from the adverse effects of air pollution stating that NPS

> *"...will seek to perpetuate the best possible air quality in parks because of its critical importance to visitor enjoyment, human health, scenic vistas, and the preservation of natural systems and cultural resources...and will assume an aggressive role in promoting and pursuing measures to safeguard these values from the adverse impacts of air pollution."*

These policies reflect the mission of the National Park Service and other authorities and responsibilities under various federal statutes, such as the Wilderness Act, which help protect NPS areas from the adverse effects of air pollution (see Table 1-1). Foremost of these is the Clean Air Act. In enacting the *Prevention of Significant Deterioration of Air Quality* provisions of the 1977 amendments to the Clean Air Act, Congress provided increased protection to certain national parks and wilderness areas designated as *Class I areas*. The Act gives park managers an affirmative responsibility to protect "air quality related values (including visibility)" from the adverse effects of air pollution. The NPS administers 49 Class I areas including one Class I international park jointly with Canada (Roosevelt-Campobello).

Although the Clean Air Act gives Class I areas the greatest protection against air quality deterioration, NPS management policies make no distinction in the level of protection afforded to any unit of the National Park System. Protecting air quality in NPS areas is reflected in the NPS' Strategic Plan, and progress in achieving air quality goals is one of the results-oriented measures used under the Government Performance and Results Act.

Understanding the impact of air pollution on national parks

Protection of air quality in national parks requires extensive knowledge about the origin, transport, and fate of air pollution, as well as its impacts on resources. In order to be effective advocates for the protection of park air resources, NPS managers need to know such things as the air pollutants of concern, existing levels of air pollutants in parks, park resources at risk, and the potential or actual impact on these resources. Through the efforts of park personnel, support office staff, and the NPS Air Resources Division, the NPS is meeting its clean air affirmative responsibilities by obtaining this critical infor-

Table 1-1. Legislative Requirements Protecting Park Air Resources

Statute	Year	Summary
NPS Organic Act	1916	Requires the NPS to conserve scenery and other park resources and to provide for the enjoyment of such resources by such means as will leave them unimpaired for the enjoyment of future generations.
Wilderness Act	1964	Requires wilderness areas to be administered "for the use of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness."
National Environmental Policy Act	1969	Establishes national environmental policy and goals to protect, maintain, and enhance the environment; requires all federal agencies to examine the environmental consequences of major proposed actions, and to conduct a decision-making process that incorporates public input.
Clean Air Act	1970 1977 1990	Establishes: (1) health- and welfare-based national air quality standards; (2) a national visibility goal of no human-caused impairment; (3) a Prevention of Significant Deterioration of Air Quality program, one purpose of which is to "preserve, protect, and enhance the air quality in national parks, national wilderness areas" and other areas of special value; and (4) acid rain control.
Park Enabling Legislation	Various	Requires parks to be managed by such means and measures to conform to their fundamental purpose.

mation and using this information in regulatory-related activities. Much of this effort focuses on monitoring the levels of air pollution in parks, documenting its effects on park resources through scientific studies, and identifying principal contributors to poor air quality in our national parks.

Pollutants of concern, their impact, and resources at risk Various air pollutants can cause detrimental effects on sensitive resources. These include pollutants emitted directly from sources such as industrial facilities and automobiles (primary pollutants) and those that are formed as a result of chemical reactions in the atmosphere (secondary pollutants). The Environmental Protection Agency (EPA) has set ambient air quality standards for several pollutants. These include fine particles, sulfur dioxide, nitrogen oxides, ozone, carbon monoxide, and lead. Ozone and some fine particles are secondary pollutants. Other particulate and gaseous pollutants of concern include heavy metals (for example, mercury), volatile organic compounds (VOC), ammonia, and toxic organic compounds.

Pollutants of most concern are ozone, sulfate, nitrate, and ammonium compounds formed in the atmosphere from the emissions of primary pollutants. Ozone has been shown to cause visible foliar injury to a variety of trees and other plants in several parks. Growth reductions in several species have also been documented. At some parks where levels of ozone have approached or exceed the ambient air quality standard, visitors sensitive to ozone have likely experienced aggravated respiratory symptoms.

Sulfates and nitrates are the principal constituents of acid rain, which leads to acidification of lakes, streams, and soils, as well as higher level ecosystem effects such as the reduction of fish populations and other aquatic organisms in streams. Sulfate fine particles are also the primary cause of visibility impairment in parks nationwide with nitrates and other pollutants playing a smaller but significant role. Pollutants can be emitted locally near parks or from distant sources but transported long distances in the atmosphere prior to their arrival in parks.

Toxic air contaminants are deposited on ecosystems where they can bioaccumulate in fish and other wildlife. Mercury, a toxic metal, accumulates in fish and wildlife tissue and is a potent neurotoxin. Thirty states have consumption advisories for specific waterbodies to warn consumers about mercury-contaminated fish and shellfish. High concentrations of mercury have been measured in sediments and fish tissue even in certain remote parts of the high Arctic. Pesticides and PCBs have been documented in lakes

"Today the park is faced with an increasing number of potential air pollution impacts from up-wind sources...."

Bill Supernaugh, Superintendent
Badlands National Park, South Dakota

Resources at Risk:
Pollutants of Concern

- *Visibility, Night Sky:*
  Fine particles (primarily sulfates)
- *Aquatic and Terrestrial Ecosystems:*
  Acid rain (primarily sulfates and nitrates) toxic air contaminants, ammonium
- *Forest Ecosystems:*
  Ozone, acid rain, sulfur dioxide, ozone precursor emissions, nitrogen deposition
- *Cultural Resources:*
  Acid rain (primarily sulfates and nitrates)
- *Fish and Wildlife:*
  Toxic air contaminants, acid rain
- *Visitor Enjoyment:*
  Visibility impairing fine particles, ozone

and fish in isolated areas such as Isle Royale National Park in Lake Superior. Toxic organics include persistent organic pollutants, such as pesticides, dioxins, and PCBs, that "mimic" estrogens and can affect reproductive systems in wildlife and humans.

Sources of air pollutants Sources of air pollution include: "stationary sources" such as factories, power plants, dry cleaners, and degreasing operations; "mobile sources" such as cars, buses, planes, trucks, and trains; and "natural sources" such as wind-blown dust and wildfires (see figure below).

Power plants in the U.S. account for 65 percent of sulfur dioxide, a primary cause of acid rain and visibility degradation; 23 percent of nitrogen oxides, a principal precursor to smog and acid rain; and 21 percent of mercury, a heavy metal which poisons fish in freshwater lakes. In addition to coal-fired power plants, other emitters of mercury include chlorine and lye manufacturing (chlor-alkali) plants and waste incinerators; mercury is also emitted during forest fires and from degassing of soils.

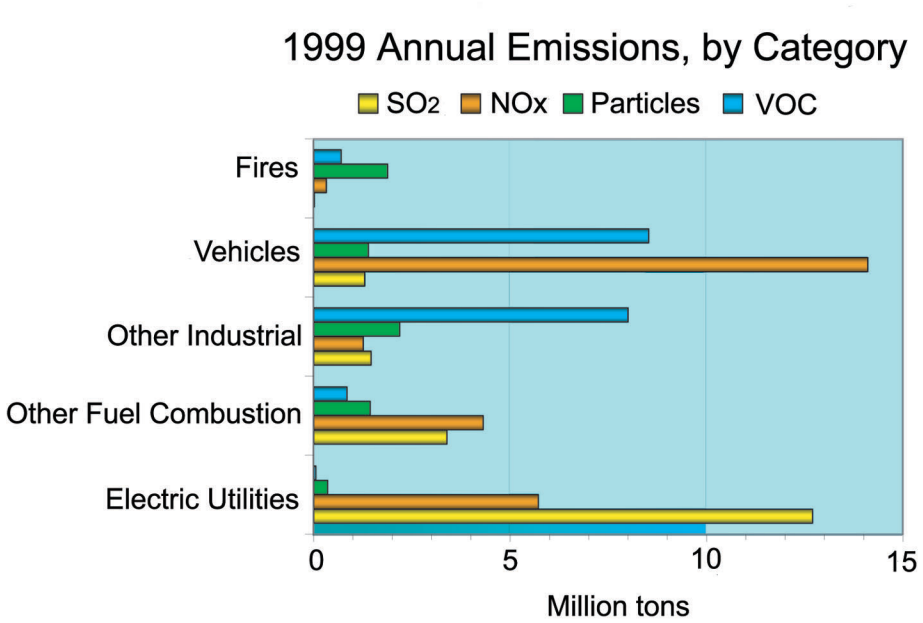
Measuring air pollutant levels in parks Historically, air pollution monitoring conducted by local, states, and other federal agencies had been inadequate in documenting levels of air pollution in national parks. As a result, in the late 1970s, the NPS initiated an extensive air quality monitoring network to gather vital information about air quality conditions in national parks. The network has grown over time through collaborative partnerships with other federal agencies and states. The map on the following page shows the location of NPS air monitoring stations, illustrates its extensiveness, and identifies those parks where some type of air monitoring is being conducted. The network includes gaseous pollutant, meteorology, visibility, and deposition monitoring components.

Visibility monitoring Visibility monitoring documents current visibility conditions and the composition of particles in the air that contribute to visibility impairment. This information is used to determine how much of the impairment is human-caused and what types of sources may be responsible for this impairment. Analyses of the monitoring data and research on the transformation and transport of pollutants in the air help NPS identify the region and sources of the pollutants that cause impairment.

Atmospheric deposition monitoring The atmospheric deposition monitoring component gathers information on both wet (acid rain) and dry atmospheric deposition as part of two nationwide monitoring networks: the National Atmospheric Deposition Program/National Trends Network (NADP/NTN) for wet deposition and the Clean Air Status and Trends Network (CASTNet) for dry deposition. This information is critical in evaluating aquatic and terrestrial ecosystem effects.

NPS Principal Monitoring Objectives

- *Determine levels of air pollutants in parks and correlate to observed effects*
- *Identify and assess trends in air quality*
- *Determine compliance with National Ambient Air Quality Standards*
- *Provide data for the development and revision of national and regional air pollution control policies*
- *Provide data for atmospheric model development and evaluation*
- *Use information to inform public about conditions/trends in national parks*
- *Determine which air pollutants in parks contribute to visibility impairment*



Annual emissions of air pollutants from different major source categories for 1999, in millions of tons. Particle emissions include fine and coarse particles.

Source: U.S. EPA

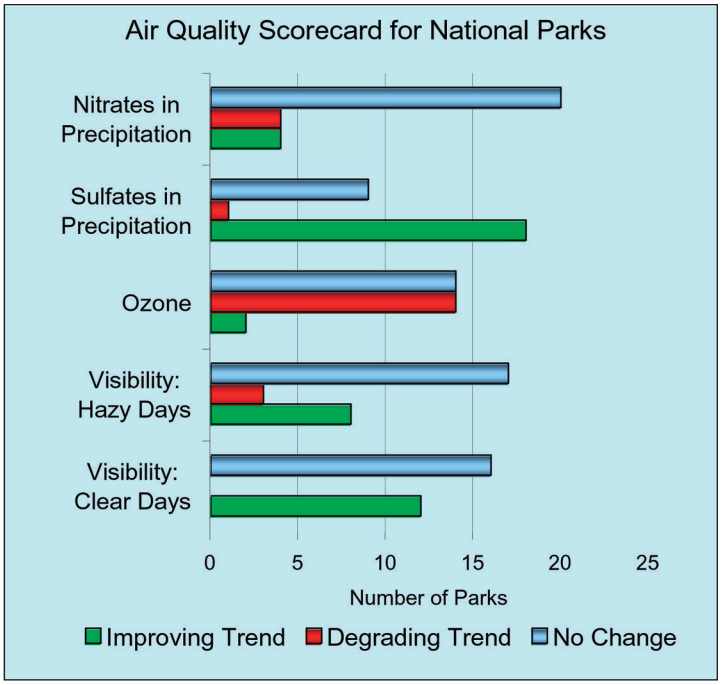
Location of air quality monitoring stations in U.S. national parks. Parks identified on the map routinely monitor one or more of the following: visibility, fine particles, ozone, sulfur dioxide, atmospheric deposition (wet and/or dry), or meteorology. Monitoring at most of these locations is conducted by NPS, with some stations operated by states or other federal agencies. Measuring air pollution levels in parks is an essential part of the NPS air resource management program and provides vital information to Congress, academia, air pollution control agencies, and the public on air pollution levels in national parks, as well as in rural America.

In addition to the monitoring described above, NPS conducts snow, fog, and cloudwater sampling in a few parks and is establishing a network to monitor levels of toxic air contaminants, such as airborne persistent organic pollutants and mercury in precipitation, on a routine basis.

Gaseous pollutant and meteorological monitoring The gaseous pollutant monitoring program concentrates primarily on determining the levels of ozone and sulfur dioxide in the parks primarily because of their toxicity to native vegetation at or below the levels of the National Ambient Air Quality Standards (NAAQS). Ozone has been measured in several parks at levels exceeding the NAAQS raising concerns about potential human health effects to visitors and employees. Meteorology monitoring complements gaseous pollutant monitoring by providing data useful in assessing measured levels of air pollutants.

Pollutant transport Sources contributing to air pollution problems in parks need to be identified so that appropriate remedial actions can be recommended to regulatory agencies. NPS often uses EPA-approved air quality dispersion and other accepted mathematical models to simulate the atmospheric and chemical mechanisms that transform and transport pollutants to national parks. The NPS uses models to identify sources, source areas, or source types that result in elevated pollutant concentrations in national parks or to predict their impact on park air quality.

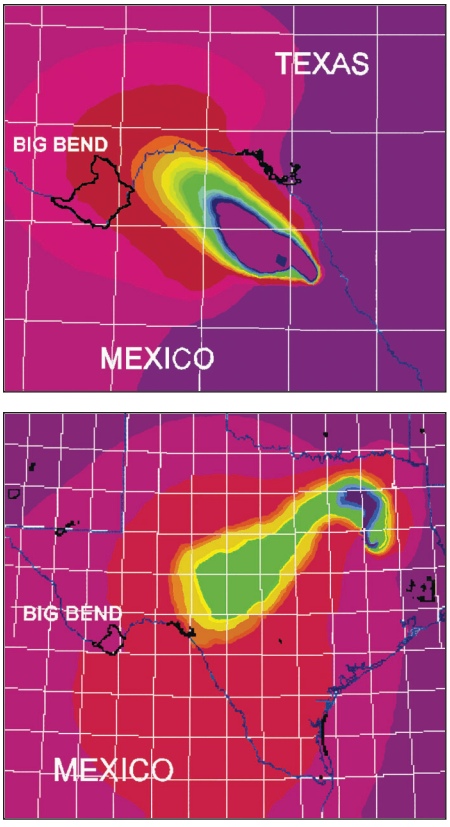
Source-oriented mathematical models simulate the transport, dispersion, and fate of pollutants in the atmosphere from known emission sources to specific locations. Air pollutant emissions from known industrial facilities are coupled with meteorological data to simulate the transport of pollutants such as sulfur dioxide, nitrogen dioxide, and reactive hydrocarbons. The models also simulate the chemical reactions that form secondary pollutants, such as ozone, sulfates, and nitrate particles. The models then estimate the amount of pollutants that are deposited on the ground as acid rain particles or as gaseous deposition, and the



Number of national parks showing a statistically significant trend for various air quality indices over the 10-year period, 1990-1999. A majority of parks show improvements in visibility on clear days and in the concentration of sulfates present in precipitation. Nearly all parks show degradation or no change in nitrate levels in precipitation. Almost half of the parks show significant degradation in ozone levels, with only few showing an improvement. Hazy conditions persist in most parks. Refer to Chapter Two for additional information on air quality status and trends.

amount that remains in the atmosphere. These estimates are used to assess the impact on resources, such as visibility impairment or the acidification of lakes or streams.

Receptor-oriented models trace the path that clean or polluted air masses traveled in the atmosphere prior to arriving at a park. These models can be used to estimate the likelihood that an area may have contributed to clean or polluted events. From the analysis of these "back trajectories" for all measurements made at a park, clean and polluted transport "corridors" can be identified. Combining the results of these analyses with information on the actual location of source areas or type of sources, the relative contribution of each source area or source type to air pollution at a park can be determined.



Source-oriented simulation modeling shows how emissions from sources in the U.S. and Mexico can combine to impact air quality at Big Bend National Park, Texas, on the same day. Park boundaries are outlined on the map.

Meeting our affirmative responsibilities Protection of air quality in national parks presents interesting challenges, because the NPS has no direct authority to control sources of pollution located outside park boundaries. Nonetheless, many actions are being taken to ensure that progress will continue to be made in meeting clean air goals for our national parks.

Communication Information about air quality conditions in parks is shared with the public in a variety of ways. Over 50 park units have exhibits with air quality related information. Several parks have real-time information about current air quality conditions available through Web sites and in visitor centers. Air quality data and issues are discussed in park brochures, newspapers, fact sheets, audio-visual programs, interpretive talks, and community-oriented educational outreach. The NPS Air Resources Division also maintains a Web site with information about air quality in parks throughout the country, including access to databases, images, and reports.

Consultation The Clean Air Act requires states to consult with the NPS prior to issuing permits for construction or modification of facilities that might affect air quality in Class I areas. During the "new source review" process, the NPS shares information about air quality conditions, potential effects on park resources, assessment techniques, and the most efficient pollution control technology. In cooperation with the U.S. Forest Service and Fish and Wildlife Service, the NPS has also developed guidance for permit applicants to help streamline the review process while at the same time ensuring that new sources will not contribute significantly to air quality deterioration in parks. As a result of NPS involvement in permit application reviews, the permitting agency and public are made aware of how new facilities might affect park air quality, and emissions from proposed new sources have been reduced.

"The whole arena of observable sky phenomena-- daytime as well as nights -- is a spectacular resource at Cedar Breaks. Any diminution of air quality combined with increased light pollution will have devastating effects on the quality of this fast-diminishing resource."

Denny Davies, Superintendent
Cedar Breaks National Monument, Utah

Once night falls, the equally magnificent night sky in national parks emerges replacing the daytime scenic views. Light pollution and air pollution combine to diminish the spectacular night sky that attracts numerous visitors to national parks.

Source: NASA

The NPS also actively promotes and supports national and regional initiatives to reduce air pollutant emissions. NPS provides advice and technical assistance to state and federal regulatory agencies that are responsible for developing air pollution control programs. Current air quality standards and regulations do not appear to have been sufficient to fully protect sensitive park resources, so the NPS has been an advocate for new standards and cost-effective pollution reduction and prevention programs, including the following items.

Motor vehicle standards The NPS endorsed the EPA's issuance of "Tier 2" mobile source emission reduction standards and gasoline sulfur standards for refineries that would significantly reduce emissions from cars and light trucks, including sports utility vehicles, minivans, and pickup trucks. Tier 2 standards will decrease emissions of hydrocarbons and nitrogen oxides, which will have numerous benefits such as reduced levels of ambient ozone, decreased particulate matter and carbon monoxide emissions, improved visibility, reduced acid rain problems, and reduced greenhouse gases and toxic air pollution. The new emissions standards will take effect in 2006 with the full effect on pollution levels expected by 2020. These standards will result in decreases in emissions even with expected increases in the number of vehicles and miles traveled. The NPS also testified in favor of new standards for heavy-duty diesel engines and off-road vehicles. EPA issued regulations for diesel engines in January 2001.

Eastern states nitrogen oxides state implementation plan order In the eastern U.S., ground-level ozone pollution routinely exceeds health standards. After a multi-year technical study on the effects of nitrogen oxide emissions across the eastern region, EPA issued a requirement that 20 eastern states must reduce emissions of nitrogen oxides to levels determined to help bring the region into compliance with health standards. NPS publicly supported this rule. This reduction should lead to less formation of ozone and nitrate and, by reducing oxidants in the atmosphere, should lead to lower formation of sulfate as well. These expected outcomes will reduce ozone levels and acid deposition in eastern parks while also improving visibility.

Regional haze regulations The NPS provided technical information and consulted closely with EPA in the development of new visibility protection regulations, which were issued in 1999. The regulations require states to make "reasonable progress" toward restoring "natural" visibility conditions in mandatory federal Class I areas. Improving visibility in Class I areas will improve visibility nationally, thereby benefiting all NPS units as well as urban areas. One of the key components of the program is that older, major stationary sources such as power plants, smelters, and oil refineries, must install best available retrofit technology (BART) if they are found to contribute to regional haze. This will result in a significant reduction in visibility-reducing pollutant emissions. The NPS helped EPA develop and publicly endorsed a rule proposed in June 2001 outlining the BART process.

EPA estimates that roadway vehicles emitted 8.6 million tons of nitrogen oxides and 5.2 million tons of volatile organic compounds during 1999.

The NPS participates in regional partnerships, such as the Western Regional Air Partnership (WRAP), a voluntary organization of western states, tribes, and federal agencies. The WRAP was formed in 1997 as the successor to the Grand Canyon Visibility Transport Commission, which made over 70 recommendations in June 1996 for improving visibility in 16 national parks and wilderness areas on the Colorado Plateau. The WRAP is implementing regional planning processes to improve visibility in all western Class I areas by providing the technical and policy tools needed by states and tribes to implement the federal Regional Haze Regulations.

Air quality related value restoration and protection rulemaking In July 2000, the NPS, through the Department of the Interior, asked the EPA for rulemaking to restore and protect air quality related values in Class I areas, and for more immediate actions to reverse deteriorating air quality trends at Great Smoky Mountains and Shenandoah National Parks, and the Blue Ridge Parkway. The EPA solicited public input on the NPS request for new tools to mitigate adverse impacts from air pollution in national parks.

Cooperation The air pollution problems in parks are often the result of pollution transported regionally, nationally, or even internationally. Therefore, the NPS must work in partnership with states, tribes, other federal agencies, non-governmental organizations, academic institutions, scientists, and a wide variety of stakeholders. These partnerships facilitate the acquisition of information, such as monitoring and research data, or help build consensus on air quality protection goals and strategies.

Recognizing the regional nature of many air pollution problems — including regional haze that degrades visibility in parks — regional planning organizations have been convened around the country to coordinate air quality planning efforts among states and tribal governments. In particular, these organizations are facilitating the implementation of the visibility protection regulations. The NPS is actively participating in these regional partnerships by lending technical expertise, assisting in the development and evaluation of various strategies, and helping inform and involve the public in the consensus-building process.

Conservation Air quality in parks is also affected by activities and facilities within parks. Parks contribute to air pollution control efforts through energy conservation, use of alternative or renewable fuels, development of alternative transportation systems, and smoke management practices. Promoting the use of energy efficiency and renewable energy technologies and educating the public about our nation's energy options are at the heart of the Green Energy Parks program. The national parks are ideal places to showcase the federal government's commitment to both promoting energy efficient and renewable energy technologies and practices, and reducing the environmental impacts associated with pollution and global climate change. To this end the Department of the Interior has partnered with the Department of Energy (DOE) whereby parks use a variety of DOE programs designed to provide technical assistance and financial resources to federal agencies interested in establishing on-site energy and water conservation and renewable energy projects. Replacing diesel generators with photovoltaic arrays at Glen Canyon National Recreation Area and Joshua Tree National Park, for example, have replaced the use of 81,000 gallons of diesel fuel and reduced annual air pollution emissions (e.g., sulfur dioxide, nitrogen oxides) by 35 tons and carbon dioxide emissions by over 900 tons at these parks.

These are some of the national and regional activities NPS is engaged in to make progress toward meeting its air quality preservation mandates. The information, expertise, and management concerns that the NPS brings to various external decision-making arenas has made a difference. Air quality-related interpretive and educational programs implemented by parks have also contributed to public understanding and support for air pollution control programs. Efforts to reduce and prevent pollution from activities and operations within parks will also help us meet this goal. However, more public participation and advocacy for the preservation of clean air in our national parks is needed if we are to:

> "... *leave them unimpaired for the enjoyment of future generations.*"